APPLICATORS AND APPLICATOR COMPONENTS

TECHNICAL FIELD OF THE INVENTION

This invention relates to applicators for applying liquids to plants in a field, garden, crop or the like, particularly selective application of weedicides to undesired plants. The invention also relates to other applicator components including applicator heads and a method of constructing applicator heads particularly applicator heads constructed of a thermoplastics material having exposed porous components such as rope wicks for applying the liquid to the plants. The method of construction may have general application to the moulding of other articles incorporating a thermoplastics material and a rope or other porous material.

BACKGROUND ART

Tractor mounted applicators for applying weedicides to crops etc are described in Australian patent No. 589361 and hand held applicators in our co-pending international applications No. PCT/AU00/00167 and No. PCT/AU98/00279. While such applicators are very effective in use, they are more expensive to manufacture and maintain than is desirable. With this in mind, the present invention is aimed at providing applicators and components for applicators which are less expensive to manufacture and result in an apparatus which is more reliable and easier to maintain. The applicator discs illustrated in the aforementioned patent and applications have a central reservoir for storing liquid chemical and each wick passes through an aperture in the wall of the reservoir and is secured therein by a gland. The flow rate of liquid through the wick is dependent to some extent on the tightness of the gland and thus is sometimes difficult to control, or requires the use of extra devices associated either with the supply of liquid to the wick or wick itself. The present invention aims to provide a method of forming applicator discs which ameliorates one or more of the problems with the applicator discs presently used. Other aims and advantages of the invention may become apparent from the following description.

DISCLOSURE OF THE INVENTION

In one aspect, the present invention resides broadly in a rotatable applicator head including a first part and a second part, the first part being moulded of a plastics material and being disk-like in form with a central recess formed therein, and said second part being secured to said first part, capping said recess, to define a liquid storage chamber between said first and second parts for storing a liquid to be applied to the surface of a field, garden or crop, and a plurality of applicator wicks extending through a wall of said recess towards the periphery of said first part and having a portion thereof within said recess, characterised in that said wall is moulded about said plurality of applicator wicks. Preferably, a portion of the first part at or near its periphery is moulded about a portion of each applicator wick to secure them against movement relative to the first part during rotation. Intermediate portions of the first part may also be moulded about the wicks for further security if desired. In a particularly preferred form in which each wick terminates adjacent the periphery of the first part, a peripheral portion of the first part is moulded about the end portion of each wick thereby forming a cap so that liquid flowing through the wick during rotation of the applicator head is prevented from flowing out the end of the wicks. In a preferred form said second part includes a Vee-belt pulley integrally moulded therewith for receiving drive from a tractor power-take-off (PTO) or other drive source.

Terms such as vertical, horizontal, upper and lower, are used herein for the purpose of description and illustration of the invention in the position it would normally be used for the application of weedicide to a field unless clearly not appropriate, and are not intended to restrict the scope of the invention to any particular orientation.

In another aspect the invention resides broadly in an applicator, comprising:

a frame assembly adapted to be attached to or drawn by a vehicle such as a tractor;

a support shaft secured to said frame assembly and depending vertically, in use, therefrom;

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a storage tank mounted on said frame assembly or adapted to be mounted on the vehicle;

a rotatable applicator head as previously described mounted on said shaft for rotation relative thereto, said shaft extending into or through said storage chamber in said applicator head and said shaft having a passage therethrough, said passage being in fluid communication with said storage chamber and said storage tank for supplying liquid to said storage chamber. Preferably, said shaft also includes a second passage therethrough in fluid communication with said storage chamber and adapted to act as a vent passage for venting the storage chamber.

In another aspect, the invention resides broadly in a hand held motor driven applicator including:

drive means having a drive housing and an output shaft;

a motor drivingly connected to said drive means;

a rotatable applicator head drivingly connected to said output shaft, said rotatable applicator head having a first part and a second part, the first part being moulded of a plastics material and being disk-like in form with a central recess formed therein, and said second part being secured to said first part, capping said recess, to define a liquid storage chamber between said first and second parts for storing a liquid to be applied to the surface of a field, garden or crop, and a plurality of applicator wicks extending through a wall of said recess towards the periphery of said first part and having a portion thereof within said recess, said wall being moulded about said plurality of applicator wicks and there being an access opening in said second part for receiving a supply of liquid;

an elongate handle operatively connected to said drive housing by which a user may maintain said rotatable applicator head proximal to the surface of the field, garden or crop, whereupon said applicator wicks may apply liquid to selected undesired plants upon contact therewith, and

a reservoir mounted on said elongate handle or said drive housing in fluid communication with said liquid storage chamber for supplying liquid to said liquid storage chamber via said access opening while said rotatable applicator head is rotating.

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In another aspect, the invention resides broadly in a method of constructing a rotor head for a motor driven applicator of the type having a first part moulded of a plastics material and being disk-like in form with a central recess formed therein and a plurality of applicator wicks extending through a wall of said recess towards the periphery of the first part and having a portion thereof within the recess including:

cutting a piece of rope wick to a desired length to extend across a face of the first part;

compressing a portion of the rope wick and moulding the recess wall about the compressed portion of the rope wick while it is compressed, and

allowing the plastics material to set before releasing the rope wick. It will be appreciated that the method may be carried out for a plurality of rope wicks extending through the recess wall.

In yet another aspect, the invention resides broadly in a method of forming a thermoplastics product with an exposed porous component, including:

providing a component formed from a porous material;

supporting at least some of the porous material in a mould;

compressing a portion of the porous material supported in the mould cavity;

injecting a thermoplastics material substantially about the compressed portion of the porous material; and

releasing the thermoplastics material and the porous material from the mould cavity after the thermoplastics material has set.

In another aspect, the invention resides broadly in a thermoplastics product with one or more exposed porous components manufactured in accordance with the method previously described.

Preferably, the compressing step is achieved by introducing a ram or pusher into the mould cavity and engaging the ram with the portion of the porous material to be compressed prior to the introduction of the thermoplastics material, and injecting the thermoplastics material while the portion of porous material is compressed, and then removing the ram prior to the setting of the

thermoplastics material, whereby the thermoplastics material back-fills the space previously taken up by the ram as it is withdrawn prior to solidification of the thermoplastics material.

Preferably, the characteristics of the materials and the parameters of the moulding process, particularly the temperature and injecting pressure, are selected such that some of the thermoplastics material penetrates part-way into the porous material in the moulding step. It will be appreciated that this will hold the rope more securely than if the plastics material simply abuts the surface of the rope and relies on the twist of the rope. In the case of the product being an applicator head and the porous material being rope wick, it is preferred that the thermoplastics material flow into the cavities and recesses between the external strands of the rope. It is believed that this will provide better control of flow so that all flow will be through the wick rather than around it.

Preferably, the method includes cutting the rope with a hot blade to prevent fraying of the ends, and also pressing the cut end into a V-shape. The rope is then preferably secured into a channel in the mould to prevent it sliding along the channel under the force of flow of the plastics material, with a length of rope passing out of the channel to provide a free end. In the case of an applicator head, the free end is destined to be located in the central recess for receiving liquid therefrom and a portion adjacent the free end (the restriction portion) is compressed and destined to have the wall of the central recess moulded thereabout, while the portion adjacent the other end is compressed and destined to be completely encapsulated. In a preferred form the whole of the rope wick between the restriction portion and the other end is partially embedded in the thermoplastics material, the thermoplastics material extending part-circumferentially around the rope and along that length whereby the plastics material when set is keyed into the rope wicks to hold them securely against the disc-like first part of the applicator head. One or more supporting bands may be moulded around that length also. The amount of compression of the restriction portion can be varied to provide a desired amount of

throttling of the wick and the injecting pressure of the thermoplastics material can also be varied for this purpose. After the thermoplastics material has set to be sufficiently rigid, the mould is opened, the product ejected, and allowed to cool before further processing.

DETAILED DESCRIPTION OF THE DRAWINGS

In order that this invention may be more clearly understood and put into practical effect, reference will now be made to the accompanying drawings wherein:

Fig. 1 is a pictorial representation of a tractor mounted applicator according to the invention shown in the in-use attitude;

Fig. 2 is a front elevation of the applicator of Fig. 1 in the same attitude;

Fig. 3 is a pictorial representation of the applicator of Fig. 1 with some of the applicator units in an out-of-use attitude;

Fig. 4 is a bottom perspective view of a rotor head disk component of an applicator unit of the applicator of Fig. 1, with the rope wicks not shown for clarity;

Fig. 5 is a bottom plan view of the applicator disk of Fig. 4 also with the rope wicks not shown for clarity;

Fig. 6 is a top perspective view of the applicator disk of Fig. 4 also with the rope wicks not shown for clarity;

Fig. 7 is a side elevation of the applicator disk of Fig. 4 also with the rope wicks not shown for clarity;

Fig. 8 is a pictorial representation of a 1/12 segment of the disk of Fig. 4 with the rope wick incorporated;

Fig. 9 is a plan view of the segment of Fig. 8;

Fig. 10 is an elevation of the segment of Fig. 8;

Fig. 11a is a plan view of a cap for the recess of the applicator disc of Fig. 4;

Fig. 11b is a sectional elevation of the cap of Fig. 11a along line 11b-11b;

Fig. 12a is a plan view of a pulley adapted to be mounted to the cap of Fig. 11a;

Fig. 12b is a sectional elevation of the pulley of Fig. 12a along line 12b-12b;

Fig. 13a is an end view of a mounting shaft of an applicator unit of the applicator of Fig. 1, on which the rotor head is mounted;

Fig. 13b is a sectional view of the shaft of Fig. 13a along line 13b-13b; and

Fig. 14 is a pictorial representation of a mounting block by which the shaft of Fig. 13a is mounted to the frame assembly of the applicator of Fig. 1;

Fig. 15 is a sectional elevation showing the main components of an applicator head for a hand held motor driven applicator according to the invention in the normal in-use orientation;

Fig. 16 is a plan view of a segment for a plastic rotor disc with a rope wick incorporated;

Fig. 17 is a sectional elevation along line 17-17 of the segment of the rotor disc of Fig. 16;

Fig. 18 is a diagrammatic sectional view showing the rope wick, die and plastic flow direction within the manufacturing die;

Fig. 19 is a diagrammatic sectional view of the rope wick of Fig. 18 showing a ram or pusher for compressing the rope in the manufacturing die;

Fig. 20 is a diagrammatic sectional view of the encapsulated end of the rope wick of the segment of Fig. 16.

The applicator 10 illustrated in Figs. 1, 2 and 3 includes a frame assembly 11 adapted to be mounted to the three point linkage of a tractor by a three point linkage mounting frame 12 and seven frame units 14 with three on each side of the centre frame unit 14a which is mounted immediately behind the three point linkage mounting frame. The outermost two units on each side of the centre unit are welded together and are arranged for pivoting up and down movement together for travel as illustrated in Fig. 3 about pivot respective pivot pins 15.

Seven applicator heads 13 depend from the respective frame units with each applicator head being rotatably mounted on a shaft 17 which in turn is clamped adjacent one end in a clamp block 18, as more clearly shown in Fig. 14. Each clamp block is welded to its respective frame unit and is of the split type which can be tightened onto the shaft by tightening two set bolts (not shown)which extend through the holes 19. This arrangement allows the shaft and the applicator head mounted thereon to be easily and quickly removed if desired.

Each applicator head 13 includes an applicator disk 21 as shown in Figs. 4, 5 and 6, but with the rope wicks incorporated as will be described later, and a top plate 22 as shown in Figs. 11a and 11b. A cup-like recess 23 is formed centrally of the applicator disk, the recess being defined by a substantially cylindrical side wall 24 and a base wall 26 with an aperture 27 being provided in the centre of the base wall. The aperture is adapted to receive therein a bearing and seal by which the applicator head is mounted on the shaft 17 as will be described in more detail later. A shoulder 28 extends around the perimeter of the side wall as shown more clearly in Fig. 6 and the top plate 22 is seated on the shoulder and sonically welded to the side wall to form a storage chamber 29 defined by the base wall, the side wall and the top plate, for liquid chemicals such as weedicide. The disc has a thickened outer rim 30 at its periphery which provides strength and moulding stability. The disk may be moulded in one piece with the rope wicks extending radially from the central recess or in a plurality of pieces, for example twelve segments 21a as shown in Figs. 8, 9 and 10, which may be then welded together to form a disc.

The discs 21 each have twelve equally spaced rope wicks 31 moulded therein and extending into the recess 23(which in part defines the liquid storage chamber 29) through passages 24a, as more clearly shown in the 1/12th segment of Figs. 8, 9 and 10, the ropes terminating in the outer rim in an end cap 32 and being held intermediate their two ends by two moulded bands 33 and 34 as can be seen in Fig. 9. In the case shown, each segment is manufactured by an injection die moulding process and the rope wicks are

incorporated during the process, one to each segment. Each rope is first cut to length using a hot knife to prevent fraying. While the cut end is still molten, it is formed into a V-shaped tip to enable proper rope placement during the die closure. The first half of the manufacturing mould has a channel into which the desired length of rope wick is placed and the second half has two spaced apart locating pins 35 which are arranged to hold the rope in position when the mould is closed.

A mobile pusher platform is provided at 36 for positively locating the rope in the channel. This platform is withdrawn at a precise moment after the plastic has been introduced into the mould. Thermoplastics material is forced into the mould and forms a longitudinal cap on the rope wick in the channel, the completed segment having the appearance of the rope wick lying in a longitudinal recess 25 extending from the side wall 24 to the periphery of the disc. The second half of the mould has projections arranged so that the rope becomes supported on a plurality of bridging portions 25a so that the wicking properties are not significantly affected by being attached to the disc. The mould also has the necessary cavities and projections for forming a radially extending rib 39 flanking each rope wick to provide additional strength and fatigue resistance. In order to suitably secure the rope wick in the side wall 24, each rope wick is compressed at the position where the recess wall 24 is to be formed by a predetermined amount and the recess wall is then formed about the compressed portion of the rope. The amount of compression applied to the rope wick and the pressure at which the plastics material is injected mostly determine the cross sectional area of the rope wick over that portion through the wall 24. Thus the wall acts to some extent like a gland and provides a means of restricting the flow rate of a particular chemical through the rope wick at a particular speed of rotation. A similar process is used to encapsulate the end portion of each rope wick in the end cap 32 shown in Fig. 8 to effectively close the end of each rope wick, the rope being pinched at 35 as shown in Fig. 17 and being allowed to stay at normal diameter within the end cap thereby being locked in as can be seen in Fig. 17.

However, the supporting bands 33 and 34 (not shown in Figs. 16 and 17)are moulded around the rope wick without any compression so that flow therethrough is not restricted.

Fig. 18 shows a portion of the die at 37 with the rope in position, and the flow of the plastic material is shown by respective arrows 38. In the process, as indicated in Figs. 19 and 20, the pusher 36 pushes the rope and deflects it to hold it in position. The pusher is pushed all the way into the die cavity, and the rope is placed manually into the channel of the first half of the mould. The V-tip end is placed 2 mm above the pusher. The die is then closed and the V-tip allows the end of the rope to slide into the channel on the other side of the die face which forms side wall 24. The plastic is injected and flows past the V-tip of the rope end. Because the V-tip is securely located at the bottom of the channel, the plastic does not dislodge the rope from the channel but compresses it along its length. If the rope end was not secure in the channel, it would be pushed along the channel and end up bunched up and deformed. Part way into the injection cycle, the pusher 36 is withdrawn and this allows plastic to backfill the exposed rope left by the withdrawal of the pusher. The die is cooled to cause the plastic to attain sufficient rigidity, then opened and the disc segment or complete disc as the case may be ejected and allowed to cool for at least 5 minutes before further work.

It will be appreciated from the foregoing description that a complete applicator head can be constructed in a very fast simple operation at very low cost with the rope wicks already mounted therein. It will also be appreciated that the applicator disk can be moulded as one piece or as a plurality of segments for example, 1/12 segments which can be welded together to form a complete disk.

The pulley 41 illustrated in Figs. 12a and 12b is moulded from a plastics material and is secured to the top cap 22 by four screws (not shown) which respectively pass through apertures 42a in the top plate and engage in the threaded bores 42a in the pulley. However, in another form of the invention, the pulley and the cap are moulded as an integral unit.

As mentioned previously, the support shaft 17 is secured to the frame assembly by the clamp 18 and each applicator head is rotatably mounted on its respective shaft which in turn is mounted to its respective frame unit. As shown in Fig. 3, each shaft extends fully through its respective rotor head and is retained thereon by a washer and nut with a bottom seal and bearing being mounted in the applicator disk abutting a shoulder (not shown)in aperture 27 and a top seal and bearing mounted in the bore 43 of the pulley against shoulder 44. It will be seen from Fig. 13b that the top bearing engages the shaft portion 46 abutting shoulder 47 while the bottom bearing engages shaft portion 48 and the nut (not shown) is screwed to the shaft end portion 49.

Two bores 51 and 52 extend through the shaft and open at the top 53 where standard hose fittings (not shown) are fitted, and at their other ends they open sideways through the shaft for fluid communication with the storage chamber 29. Both bores are connected by hoses (not shown) to a storage tank (not shown) mounted above the frame assembly 11, one hose being a supply hose connected to the lower part of the tank and connected to bore 52 while the other hose enters the tank above water level and is connected to bore 51 to act as a vent for the liquid storage chamber 29.

The applicator heads are driven by the tractor PTO via a right angle gearbox (not shown) mounted to bracket 20 with Vee-belts being drivingly connected to the output shaft of the gearbox and the centre applicator head as well as the applicator heads on either side which in turn drive the next outer applicator heads and so on as can be seen in Fig. 2.

The hand held motor driven applicator 109 illustrated in Fig. 15 has an applicator head 113 which is constructed in a similar manner to that described in relation to the applicator 10, the wicks not being shown for clarity. The operation of the hand held applicator has been described in our co-pending international application No. PCT/AU00/00167 and the specification relating to that application is incorporated herein

by way of reference to the extent necessary for a complete understanding of the operation of that applicator..

Various modifications of the invention are contemplated which will be apparent to persons skilled in the art, and which can be resorted to without departing from the spirit and scope of the invention as defined in the appended claims.